assume smaller companies cannot attain the same discount levels as large LECs. The authors support this assumption by presenting a comparison of RUS versus Bell Atlantic cable material costs, and suggesting the application of a factor to adjust cable material costs for large LECs. Additionally, no evidence is presented that the installation costs from the RUS contracts are reflective of large LEC contracts.

B. 18, 19, 22 and 24 Gauge Cable Used

Our understanding, based on conversations with RUS engineering experts, is that RUS loop design standards include 24/22 gauge wire in copper loops to achieve a maximum distance of 18 kilofeet without extended range line cards. As a result, the RUS material costs for copper are not appropriate for either BCPM 3.1 or HAI 5.0a, since both proxy models use exclusively 26 and 24 gauge copper wire in their loop designs.

An examination of the "conduit, poles, drop, cables.xls" Excel workbook, which was used as input for the NRRI regressions, shows the following:

Cable Gauge	Sheath Feet of Cable	Percent of Total
18	27,758	.135%
19	158,359	.770%
22	5,148,461	24.047%
24	15,220,177	74.046%
26	260	.001%

Obviously, Dr. Gable's analysis does not reflect the sponsors' forward-looking network design which is based upon a predominately 26 gauge cable.

Similarly, Table 2-3 in the Gabel Report is presented as an example of weighting methodology. The material items used in this example lead to questions about the applicability to sponsors' environment. The largest number of cable pairs used in this

example is 12, however, the smallest cable the sponsors generally use for distribution cable is 25 pairs. The practice of limiting the smallest cable size to 25 pairs is based on economics.

D. *Lack of Flexibility*

Many of the engineering assumptions and equipment selections are embedded within the cable cost functions' input data in Dr. Gabel's analysis. Thus, the model has an inherent lack of flexibility that violates the FCC's criterion number nine for proxy models:

> The cost study or model must include the capability to examine and modify the critical assumptions and engineering principles. These assumptions and principles include, but are not limited to, the cost of capital, depreciation rates, fill factors, input costs, overhead adjustments, retail costs, structure sharing percentages, fiber/copper cross-over points, and terrain factors. [8]

As discussed above, the cost functions (and their underlying data) inherently reflect the predominant use of 22/24 gauge cable and an 18 kilofoot loop breakpoint which cannot be modified to reflect different engineering assumptions. Moreover, as noted earlier, BCPM uses predominately 26 gauge cable in its loop design.

E. *Structure Sharing*

The NRRI cable cost formulas do not support the FCC's proxy model specifications for structure sharing. Indeed, the authors are unsure to what extent structure sharing is reflected in the cost functions. The FCC concluded that the selected proxy model platform should allow for input of discrete structure sharing percentages by installation activity and terrain, and that "the selected mechanism should adopt BCPM's categories for installation activities and terrain conditions."[9] Furthermore, the structure sharing levels are to be differentiated by line density zone. In other words, the FCC has specified that the selected platform will calculate the total cost of each installation

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[8] Report and Order at ¶250.

[9] FNPRM at ¶79.

activity, and separately apply discrete structure sharing percentages to adjust the cost for sharing. The NRRI formulas, because they "largely reflect the costs incurred by the LECs after taking sharing into account,"[10] cannot be used in the platform design specified by the FCC.

The extent to which the NRRI study confuses the structure sharing issue is illustrated by the authors' discussion of sharing in new developments. The study says that "the cost of opening up the ground is born by the developer."[11] While this conclusion is not necessarily incorrect in all cases, the amount of structure sharing is a critical assumption that should be modifiable by the model user.

In summary we believe, and the FCC has confirmed in its platform design specifications, that structure sharing can vary widely due to local conditions. Structure sharing is the subject of intense examination and debate by model proponents and interested parties. Therefore, the FCC requires a cost proxy model have unique inputs for structure sharing. The data provided by Dr. Gabel does not meet this criteria.

2. Switching

A. NRRI Report Overlooks BCPM 3.1

Inexplicably, the NRRI report critiques the BCPM version 1.1 switch model, ignoring BCPM 3.0, released on December 11, 1997, and BCPM 3.1, first made available in February, 1998. One criticism centers around the fact that the early BCPM 1.1 switch cost functions did not distinguish, on a per line basis, between the cost of host and remote switches. The code for the BCPM 1.1 would have to be changed to use separate host and remote functions.[12] BCPM 3.1 includes inputs for separate, significantly different, switch cost functions for host, remote, and standalone switches. The Gabel report says that "both of the proxy models arbitrarily split the per-line investment between usage and the

[10] NRRI study at 34.

[11] NRRI study at 34.

[12] NRRI study at 120.

port cost."[13] This is not true of BCPM 3.0 and 3.1, which specifically calculate both port and usage costs.

B. Support of FCC Public Notice Recommendations

- Separate Identification of Host, Remote, and Standalone Switches

The FCC Common Carrier Bureau recommended that "the components of the models that estimate switching investment costs employ separate cost curves for host, remote, and stand-alone switches."[14] The NRRI study only partially supports this recommendation because it develops separate equations for remotes only, leaving the hosts and standalones combined. BCPM allows the input of separate functions for all three types of switches. BCPM is supplied with discrete switch investment functions, showing significant differences between hosts and standalones.

The NRRI large LEC model does not allocate the host wire center cost of terminating remote switches to the remotes, but to the hosts.[15] The study acknowledges this problem but downplays it, saying "the authors do not believe that this understatement causes a large distortion." Nevertheless, estimates from a properly designed engineering model, such as those used in BCPM, reflect these costs properly.

- Switch Capacity Constraints

The Bureau recognized that there are generally three capacity constraints upon a central office switch: lines, busy-hour call attempts, and busy-hour usage (CCS).[16] We believe that any valid switch cost formula should recognize the effects of all three capacity constraints upon total switch cost. The NRRI study, while confirming the

[13] NRRI study at 106.

[14] Public Notice at 2.

[15] NRRI study at 110.

[16] Public Notice at 3.

importance of all three inputs, bases its variable investment per switch on only the number of lines:

> This linear specification of the investment function is widely used for modeling costs in the telecommunications industry. For the purposes of this exercise, there is an important limitation of the model specification. There was no data on the number of busy-hour messages or busy-hour minutes-of-use, both of which measurements of usage affect the level of investment. Because there is no publicly available data on the level of usage by switch location, these variables were not included in the analysis.[17]

The resulting switch cost equations cannot reflect varying inputs for calls and CCS per line, which the Bureau specifically recommends that the models accept.

- Percent of Switch Assigned to Port

The Commission concluded in the FNPRM that all of the line-side port costs should be assigned to universal service.[18] It further sought comment on a reasonable percentage of switch costs to assign to the line port.[19] A simple total switch cost function, such as the NRRI model, does not identify line-side port costs. Furthermore, actual line-side port costs vary greatly depending on vendor switch technology. As a result, the NRRI cost equations (or any other single-function switch cost equations) cannot possibly meet this requirement without arbitrary allocations.

The BCPM switch curve, by contrast, computes specific port costs by switch vendor. BCPM specifically determines, for each wire center, the amount of investment for the line port and MDF/protector.

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[17] NRRI study at 95.

[18] FNPRM at ¶ 137.

[19] FNPRM at ¶135.

- Percent of Switch Assigned to Universal Service

The Commission concluded in the FNPRM that a percentage of usage-sensitive portion of the switch should be assigned to universal service. In addition, trunk port costs should be included in usage. The Bureau recommends that this approach to identifying universal service costs should be accommodated by the models.[20] As with the line port, the total switch cost function cannot identify with specificity the total usage-sensitive portion of the switch, making it impossible to subsequently identify the portion attributable to supported services. Likewise, such a model cannot assign trunk port costs to usage, as the trunk port costs are not separately identified.

C. ***Embedded Costs, Not Forward-Looking***

The NRRI study presents two sets of regression results for large LECs. The first uses switching investment data for the years 1985-1995. The second covers the years 1993 to 1995. We cannot support the use of the 1985-1995 data for any forward-looking cost study. First, these embedded costs must be adjusted by some price index to current-year levels. In our judgement, indexing costs over periods of 7-10 years could severely distort the numbers (any inaccuracies in the price indices would be repeatedly compounded). Second, price indexing does not capture the cost effect of technological advances. Switching machines produced in the 1980's have nowhere near the power and functionality of current model switches. Thus, their cost characteristics are irrelevant to a forward-looking view.

The FCC's Universal Service order clearly specifies that the "costs must not be the embedded cost of the facilities, functions, or elements. The study or model, however, must be based upon an examination of the current cost of purchasing facilities and equipment, such as switches and digital loop carriers (rather than list prices)."[21] While

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[20] Public Notice at 3.

[21] FCC Report and Order, "In the Matter of Federal-State Joint Board on Universal Service", CC Docket No. 96-45, released May 8, 1997, at ¶250.

the NRRI study's 1993-1995 analysis is clearly preferable to the 1985-1995 view, even it is based on technology that is between three and five years old as of 1998. Clearly, a better approach is an engineering-based analysis, such as the one that supports the BCPM switch curve. Such an analysis can be verified to include the most current technology for which information is available. The engineering model designs a network in which all switch nodes use current technology, whereas the NRRI and similar regression estimations provide a network of indeterminate, embedded technology.

D. Costs Other Than Universal Service Included

The NRRI large switch model is based on the investment data from the books of the Regional Bell Operating Companies (RBOCS), and as a result includes costs other than those for switching voice calls.[22] The switch costs include equipment, such as that for ISDN, Centrex line cards and feature hardware, used for services other than universal service. The study acknowledges that this can create overstated investment results for large LECs. The authors claim that "the estimates from the RUS data [used in the small LEC curve] are not contaminated in this fashion,"[23] although the issue is not addressed in the discussion of the small switch methodology.

Engineering based cost functions, such as those included with BCPM 3.1, do not have these problems. We know with assurance that the BCPM investments used for universal service include only those for basic telephone service, because the investments were developed "bottoms-up" from engineering formulas.

E. Geographic Deaveraging

Because the NRRI study combines switches from several vendors, it in effect creates a cost function that is averaged nationally. BCPM, by contrast, allows the user to specify, for each large wire center, the vendor of the central office switch. This can have a significant effect upon the wire center-specific costs of the line port, a key element of

[22] NRRI study at 123.

[23] NRRI study at 123.

universal service. The percentage of the switch investment attributable to the port can vary upwards of 100% depending on the switch vendor and switch size. The NRRI study's single cost function cannot reflect these real cost differences between wire centers.

F. Switches Less than 1000 Lines Excluded

The NRRI large LEC model developers excluded switches with less than 1000 lines of capacity. As the authors say, "caution must be exercised when parameter estimates for a data set are used to forecast for instances for which the data set has no similar observations."[24] In other words, the model may not give valid cost estimates for switches under 1,000 lines.

G. Company-Specific Discounting Not Reflected

Effective discounts received by LECs for switching equipment may vary significantly depending on the switch vendor, LEC size, dollar amount of purchasing commitments, and even a LEC's installed base of switches. In addition, switch vendors are believed to offer special incentive discounts, such as those for replacement of analog switches, that may not be available to all LECs. The NRRI switch cost estimates, because they incorporate data from a number of LECs, represent a blended discount level that may or may not be reflective of any individual company's discount levels.

The large LEC switch curve provided with BCPM, by contrast, reflects costs at vendor list prices. User inputs specify vendor discounts for growth jobs and new switch replacements. Company-specific vendor discounts can be input by each BCPM user, ensuring that actual LEC price levels are reflected.

H. Valid Applications

The BCPM sponsors believe that the NRRI study can potentially produce reasonable results at the total switch level. These results can be used to verify or to perform a "reasonableness check" of the total switch investment results produced by other switch cost models. The NRRI estimates are useful at the service-specific level

[24] NRRI study at 112.

only if they are filtered through additional input from an engineering based model, as are the NRRI small LEC estimates used as input to BCPM. BCPM's additional input, expressed as the percentage of total switch investment attributable to each switch functional investment category, allows the model to produce meaningful line termination and usage investments from the undifferentiated input.

CONCLUSION

We can support use of the NRRI cable cost functions only as an analysis tool for evaluating the reasonableness of cost data input to other models. However, the results cannot be used to determine support levels for high cost areas of non-rural LECs, because they are based solely on rural design criteria and cost characteristics and do not reflect the costs the BCPM sponsors will incur in providing universal service. The cost functions cannot be used as input to the two cost proxy models currently under consideration by the FCC because they do not fit within the FCC's guidelines and recommendations. Furthermore, the material prices used in the estimates are for cable gauges different from those used in the proxy models under consideration.

The NRRI single-variable switch cost equations cannot supply detailed enough cost information required to support the FCC's guidelines and recommendations for cost proxy models. It is impossible to determine the costs of universal service from such equations. Any service-specific model outputs from the equations, unless they are filtered through an engineering based "bottoms-up" cost model, would necessarily be based upon arbitrary assumptions about the functional cost characteristics of the switch. Such outputs would in turn send the wrong signals for determining the amount of subsidy for universal service, potentially causing inefficient market entries and creating exactly the sort of implicit subsidies that the Telecom Act was designed to eliminate.

The NRRI cost equations are useful as an alternative evaluation tool, to ensure that the engineering based cost models produce reasonable results at the total switch

level. For universal service, the NRRI cost equations are not a valid alternative to inputs based on properly constructed "bottoms-up" engineering-based models, because the equations cannot separately identify all of the costs of universal service. Furthermore, we have demonstrated that such a simplistic cost function cannot meet the FCC's guidelines for cost proxy models. Additionally, the cost estimates cannot reflect company-specific vendor discounts.

CERTIFICATE OF SERVICE

I do hereby certify that I have this 1st day of June 1998 served the following parties to this action with a copy of the foregoing JOINT COMMENTS OF BELLSOUTH TELECOMMUNICATIONS, INC., U S WEST, INC., AND SPRINT LOCAL TELEPHONE COMPANIES TO COMMON CARRIER BUREAU REQUEST FOR FURTHER COMMENT ON SELECTED ISSUES REGARDING THE FORWARD-LOOKING ECONOMIC COST MECHANISM FOR UNIVERSAL SERVICE SUPPORT by placing a true and correct copy of the same in the United States Mail, postage prepaid, addressed to the parties listed below.

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